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OFFSHORE PETROLEUM EXPLORATION
AND DEVELOPMENT IN THE BEAUFORT SEA

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EVIDENCE PRESENTED ON BEHALF
OF COPE

BERGER INQUIRY -- DELTA PHASE

Inuvik, January 1976

MACKENZIE VALLEY PIPELINE INQUIRY
EXHIBIT NO. 441 A E Jan. 28/76
Inuvik NWT.
PUT IN BY C.O.P.E.

Q. Would you describe your Arctic work experiences.

A. From 1966 to 1970 I directed a program of research on wolves and caribou in Central Baffin Island. I was personally involved in the research during three field seasons, 1966 through 1968. The greater part of that program was sponsored by the Canadian Wildlife Service, which was then affiliated with the Department of Indian Affairs and Northern Development. That project represented my first experience in an Arctic ecosystem and provided me the opportunity to gain some firsthand appreciation of Arctic ecology. Since much of the work was conducted in the general vicinity of Distant Early Warning (DEW) Line sites, it also resulted in my becoming acutely aware of the potential threats that are posed to Arctic ecosystems by development programs of one kind or another. Basically, however, my work on Baffin was that of a scientist pursuing research on the ecology of large mammals, an area of basic research which I was involved in between 1950 and 1970.

From September 1973 to August 1974 I was a Resource Worker with the Committee for Original Peoples Entitlement (COPE) at Inuvik, N.W.T. The work with COPE was completely different from my work on Baffin Island. I was not conducting scientific investigations but was called upon to use a wide range of skills and knowledge

which had been developed as a result of my scientific pursuits, my work in government, my interest in, and investigation of, environmental problems, in work with the Science Council of Canada and the Canadian Arctic Resources Committee.

Finally, from 1969 to the present I have spent a lot of time reading, thinking and talking about Arctic environmental questions and problems. This has been supplemented by seeking opportunities to gain personal insight and understanding. For example, in 1971 I went on the first pipeline route flight conducted by Canadian Arctic Gas; in 1974 I walked from the north end of Richards Island to Tununuk at the south end to study the impact of various oil and gas activities on the tundra environment. I was accompanied on that trip by Roy Raddi of Tuktoyaktuk. In 1975, I travelled by freighter canoe down the Mackenzie River from the lower reaches of the Great Bear River to Inuvik so that I could better understand the country which may eventually be traversed by gas and oil pipelines.

Q. What insight can you provide on the extent of scientific knowledge of Arctic marine environments, and the scope of ecological research?

A. During 1969 I was involved in a background study of fisheries and wildlife in Canada for the Science Council of Canada. Our investigations showed that exploration for, and

development of energy and mineral resources in the NWT and Yukon was far ahead of knowledge of the components of and the interactions within Arctic ecosystems. The imbalance was so pronounced that we recommended that an intensive program of research related to the various aspects of oil and mineral developments needed to be undertaken immediately.

It became very clear to us that the research that was being conducted by members of the Arctic Biological station of the Fisheries Research Board of Canada (now incorporated into Environment Canada) on marine environments in the Arctic was minuscule in terms of the knowledge that was needed as background to petroleum exploration and development programs which would eventually be undertaken in offshore areas. Three years later (1972) when CARC held its first workshop, a report by an eminent marine ecologist indicated that nothing significant has been done to improve the situation in the interim even though Imperial Oil was about to submit an application to construct its first artificial island in the Beaufort Sea for the purpose of drilling and DIWA was moving to request cabinet approval for drilling in deepwater areas of the sea. To sum up, during the 1960's and the early 1970's when the stage was being set for intensive petroleum developments in offshore areas, very little was done to gain the knowledge which would be needed to assess the impact of development on environment or on animals such as seals,

whales, birds and fish, which are so important to the way of life of the native people of the Mackenzie Delta.

Q. What is your opinion regarding the proper relationships between research and development?

A. In the last half of the 1960's direct relationships should have been drawn between offshore oil and gas developments, potential environmental problems and the need for ecological research. In 1969 the relationship was well enough understood that a special conference on Arctic ecology and conservation was held at Edmonton under the sponsorship of the international union for the conservation of nature and natural resources. About the same time the Hon. Jean Chretien, then minister of Indian Affairs and Northern Development, gave a speech to a national organization pledging that Arctic ecosystems would be protected.

Q. Specifically how did you become involved in an investigation of offshore drilling?

A. In September 1973 I joined COPE at Inuvik as a resource worker. Soon after I was invited to attend an environmental conference sponsored by the Arctic Petroleum Operations Association. It was held in Yellowknife in October

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 74. At the conference I overheard a discussion which alerted me to the fact that wildcat, exploratory drilling in deepwater areas of the Beaufort Sea was due to start in 75. In spite of my associations with the Science Council and with CARC, I was unaware that drilling was due to start



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so soon. When I reported this to Sam Raddi, President of COPE, he too was very surprised, and realizing the potential significance of offshore operations to the native communities which COPE represented he asked me to conduct an immediate investigation for COPE. I agreed and worked on it as one of a number of activities from late October 73 til January 74 when I submitted my report. Early in February 74 the report was reviewed at a meeting of COPE's Board of Directors at Paulatuk. Subsequently COPE issued a news release and made the report public. Both documents are included as appendix A.

Q. How would you describe your work on offshore drilling?

A. I think that my COPE report would be most appropriately referred to as investigative journalism. I think that the approach I used was similar to that used by reporters who are assigned to investigate topics or issues for which little information is available to the public.

My later work was a more detailed study of offshore drilling in the Canadian Arctic which involved documentation of all sources^{of} information. It was more sophisticated and involved the methodology and the approaches used by both journalists and political scientists in investigating and reporting on complex environmental and socio-political questions. I have considerable practical experience in

investigating and reporting on topics of this nature. I have also learned a great deal about how to draw on areas of knowledge and expertise for which I have no formal education.

Q. Earlier you stated that you were unaware that wide-scale offshore drilling operations were imminent when you joined COPE. Could you explain?

A. I had already been involved with CARC for more than 2 years and had been taking an active interest in Arctic affairs for some years before that. It appeared that both government and the petroleum industry had been keeping plans for offshore drilling secret. I believe that the intention was to advance offshore operations to a fait accompli situation before the public and particularly native peoples and environmental organizations became aware of what was happening and what would be involved. At any rate the approach was effective in keeping information on plans for offshore drilling from coming to public attention. This effectiveness was attested by the fact that Wally Firth M.P. for the N.W.T. heard first about the plans for operations in deepwater areas from the COPE news release and report.

Q. What evidence do you have to support your statement that the intention was to advance operations to a fait accompli situation before information reached the public?

A.(1) In December 1972, the Department of Indian Affairs and Northern Development convened the Northern Canada Off-

shore Drilling Meeting. It was attended by members of a number of government departments, by representatives of petroleum companies which had holdings in the Beaufort Sea area, and by some engineering companies which serve them. It was closed to the press and to the public generally. When I began the investigation for COPE almost a year later I learned about the conference but was refused access to the Proceedings. The excuse given was that they contained proprietary information that was protected by agreements between government and industry.

(ii) On July 31, 1973, the Federal Cabinet considered the question of offshore drilling in the Beaufort Sea and gave approval-in-principle to it. However, no information on the decision was made public until after the release of the COPE report, in February, 1974.

(iii) Although the desirability of informing native people about plans for offshore drilling was discussed at the Northern Canada Offshore Drilling meeting by Mr. Digby Hunt and Mr. Barry Yates of DINA, nothing was done until an offshore issue of Dialogue North was published approximately 18 months later. By then they had already been informed about it by COPE and by an article in Inuit monthly.

(iv) In the winter of 1973-74, Panarctic drilled its first offshore well from reinforced ice in Hecla and Griper Bay north of Melville Island. No information was made available to the public on the operation until the final

stages when some reporters visited the site.

- (v) Approval-in-principle was given to Norlands Petroleum to drill a well in Lancaster Sound but no information became available to the public until it was reported in an issue of Northern Perspectives from information obtained from confidential government documents.
- (vi) The drilling from the first artificial island in the Beaufort Sea established a precedent since it marked the transition from land to marine operations in the search for oil and gas in the Arctic. However, it was treated very casually by government and industry. Instead of being licensed under the Arctic Waters Pollution Prevention Act, it was dealt with under the Land Use Regulations of the Territorial Lands Act; approval for the application was sought only from the Tuktoyaktuk Hamlet Council although it dealt with a matter which was of concern to several other communities; no public statement or news releases about the event were made by either government or industry, and the land use application had to be processed by all organizations concerned within the 30 day period which is specified in the land use regulations.

Q. What action did you take to obtain information on offshore drilling from government and the petroleum industry?

A.(i) In the initial stages of the investigation, I made a verbal request for information, and particularly for the Proceedings of the Northern Canada Offshore Drilling Meeting, of the Regional Director of DIAND at Yellowknife. On November 1,

1973, I wrote Mr. Chretien and requested copies of all information which had been made public on offshore drilling. I received a reply to that letter on January 29, 1974 advising that no information had been released. In early December, following further specific requests for information, DIAND made available copies of papers given by members of government at the Northern Canada Offshore Drilling Meeting. The Department would not, however, provide copies of the papers given by members of industry, or the transcript of the discussions which ensued.

Similarly, I wrote Imperial Oil and Panarctic Oil, the latter on two different occasions. Imperial Oil sent me a copy of an article on the construction of Immerk, which had appeared in an engineering journal, but no other information. I also made verbal request of Mr. Murray Morrison, of DIAND, for the opportunity to review the documentation provided the Land Use Advisory Committee by IOI on the construction and drilling proposals for Immerk. Mr. Morrison, who was chairman of the LUAC at the time, said he would look into the matter and advise me about it. However, I did not hear further from him about the matter.

In the case of Panarctic Oils, I first wrote Mr. H.J. Strains, Vice-President. He replied by referring me to Mr. Hetherington, President of the company. Later I wrote to Mr. Hetherington for information on research conducted

by the company but did not receive a reply from him.

Finally, I wrote to Environment Canada and, subsequently, in mid-December, met with three members of the Department. My objective was to determine if any information had been made publicly available, and to learn if the Department could provide any information on offshore drilling, or on the research program on the Beaufort Sea which by then was being planned. I was advised that no information had been released by the Department. In early February, shortly after the COPE report had been submitted, I received a preliminary outline of the research programs for the Beaufort Sea Project.

- (ii) When it became clear that no information would be made available on offshore drilling from official sources, I made a deliberate attempt to obtain classified information from unofficial sources. Dougald Brown, who was then working with CARC at Ottawa, assisted me. The report to COPE on offshore drilling was substantially based on classified information obtained in this way. Information obtained in a similar way and of a confidential nature was an important component of subsequent publications on offshore drilling.

Q. You attended a conference on the Beaufort Sea in January 1974. Will you describe it and state what you learned from it that was relevant to the COPE investigation?

A. The Beaufort Sea Symposium was held in San Francisco in

January, 1974. It was sponsored by the Arctic Institute of North America (AINA). It was a multidisciplinary gathering, the first major one where scientists came together to present papers on research conducted on the Beaufort Sea ecosystem. I attended it because I thought that it would be an opportunity to gain more understanding on how well prepared we were, in terms of scientific knowledge, to cope with offshore drilling activities in the Sea. The Symposium had obviously been stimulated by the imminence of offshore operations (it received financial assistance from the petroleum industry and a number of companies were represented by members of their environmental staffs). However, I did not learn very much of value to the report I was preparing to write for COPE. In fact, I was amazed by the approach which had been taken by the organizers of the conference and by the atmosphere which prevailed at it. In the first place, only rarely did any of the scientists involved make any attempt to relate the state of knowledge in their disciplines to oil and gas developments which were already underway, or in the offing. When I attempted to do this in the question periods I encountered hostility and inadequate answers. The scientists present wanted to talk about permafrost, pingos, scours in the sea floor, winds and currents, but did not want to attempt to relate what they knew to what was about to happen. In addition, no time was allocated in the program for applied discussions.

of this nature. The approach to the organization and conduct of the symposium would have been appropriate if it had been held a decade earlier, but was inappropriate considering the situation which existed at the time. All fall I had been running into blank walls in the search for information on offshore drilling from official government and industry sources. In retrospect, it seemed to me that even independent scientists, who should care about the Beaufort Sea had become part of a conspiracy of silence on matters of great import to the future of a vital part of the Arctic Ocean, and to native people who depend on its resources.

Q. In your opinion, how adequate was the scientific knowledge base in the early 1970's with regard to offshore exploration?

A. 1973 was the year DINA gave Imperial Oil approval to drill from Immerk, and Cabinet gave approval-in-principle for offshore drilling in deepwater areas of the Beaufort Sea.

As a basis for those decisions it was totally inadequate, so much so, that it is apparent that environmental considerations could not have been an important component in the decision-making processes. In the question section on one of the sessions at the Beaufort Sea Symposium, I asked the panelists to provide an assessment of the adequacy of scientific knowledge in their disciplines to support the development of petroleum resources in the Sea. I suggested

that their responses be based on a scale of 1 to 10, with 1 representing a rudimentary state of knowledge and 10 representing a situation where environmental impact assessments could be formulated without further research. The panelists were very reluctant to discuss the state of knowledge in such terms. However, one member of the panel finally responded by saying that, in terms of similar bodies of water in southern areas of the continent, knowledge of the Beaufort Sea stood at about an 1890 time base. Subsequently, in private discussions, I asked a number of the scientists to respond; in only one instance was the state of knowledge rated higher than 2 on the scale I had proposed. Subsequently, in my review of research I found much evidence that indicated that when those decisions were made, knowledge of the Beaufort Sea environment was rudimentary, in most cases at square one on the 1 to 10 scale mentioned earlier. Let me give one example for a vitally important area, knowledge of winds, waves and storms in the Beaufort Sea. Part of APOA Project 13 was a hindcast study of waves and wind conditions in the Beaufort Sea. DINA's position paper on offshore drilling stated that the winds were calculated from weather maps and the waves calculated from those winds and fetches, since wind measurements were practically non-existent. In other words, the design for the drilling system for the Beaufort Sea had to be based on theoretical data for wind forces and wave characteristics.

Q. What was done to interpret existing knowledge so that it could be related to the decision-making processes involved in offshore drilling from artificial islands and drill ships.

A.(1) On August 13, 1971 IOL submitted an application to construct its first artificial island Immerk. The application was supported by a number of documents including a report titled Offshore and Tidal Flat Artificial Island Construction Mackenzie Delta-Beaufort Sea (Appendix) The report contained four sections: A, The Environment, B, Offshore Island Construction, C, Exploratory Drilling Operations, D, Environmental Impact. The report was 19 pages long. All information on the environment and on environmental impact resulted from existing reports and maps. It did not contain any data that were credited to studies conducted by, or for IOL. In fact, the bibliography listed only one report on animals or plants that was specific to the area. The single reference to it indicated that it was of minor importance.

The statement on environmental impact which it contained was without scientific merit and valueless in terms of the subject it discussed. In four pages on the marine environment the discussion considered what effect oil operations may have under the following headings: thermal changes, changed salinities, chemical effects, denudation of the bottom, hydrocarbon spillage, sediment dispersion, noise and traffic.

The environmental impact of hydrocarbon spillage was dealt with under two hearings: (1) Offshore Island Construction: "Hydrocarbon spillage during this part of the operation would have as its only source fuel or lubricating oils. Proper operating practices during fuel transfer operations must be relied on to ensure no spillage occurs". (2) Exploratory Drilling Activity: "the most potentially serious problem that could arise would be massive hydrocarbon spillage associated with a blowout. As pointed out in Section C, all operational precautions will be taken to prevent the occurrence of blow-outs!" Three paragraphs of equal scientific stature dealt with the advantages of artificial islands if blowouts occurred and one other stated what the company was doing about the development of a contingency plan.

In summary, the serious inadequacy of the report and, in particular, the section on environmental impact supports my earlier statement that environmental considerations could not have been an important component in the decision to approve drilling from Immerk.

- (ii) In the case of the Cabinet decision to give approval-in-principle to drilling in deepwater areas of the Beaufort Sea, I believe I reviewed all important internal government documents and I was in a position to make a more direct assessment. The documents re-

viewed included the Proceedings of the Northern Canada Offshore Drilling Meeting, the Position Paper on Oil and Gas Exploratory Drilling in the Offshore Region of Canada's Arctic, and the draft memorandum to Cabinet on offshore drilling. In terms of the question asked, the Position Paper was the most definitive document. It reviewed the state of knowledge and its application in very general terms. It is clear from it that no attempt was made to formulate an environmental impact assessment prior to Cabinet consideration. This conclusion is borne out by a memorandum from a Special Assistant to the Minister of the Environment to the Deputy Minister of the Department which was written 10 days after the Cabinet had given approval-in-principle to offshore drilling: The memorandum, about a proposed project for the Canadian Environmental Advisory Council, stated in part:

"Another point the Minister raised in his telephone response to this letter was that you bear in mind the recent Cabinet approval of the oil drilling in the Beaufort Sea paper. This approval for the granting of permits to drill, has been given without enough time to do proper environmental assessment work. If the Council knew that we were about to go ahead with this work and had their environmental impact model handy, we could end up caught in the glue". (Memo-

random dated Aug. 10, 1974 from Diana Pethick, Special Assistant to the Hon. J. Davis, Minister of Environment Canada, to Mr. R.F. Shaw, Deputy Minister.)

Q. What do you know about industry's Environmental Impact assessment for Immerk?

A. The 1972 study was undertaken to assess the impact of the construction of Immerk and was done concurrent with construction. Its sole purpose was to deal with the environmental impact of construction of the island. F.F. Slaney conducted the study and made that point clear in its letter of transmittal:

"According to our terms of reference, both the study aspect of the project and the environmental statement have dealt specifically with the matter of construction of the artificial island Immerk, along with directly associated activities. Eventual disposition or use of the island in any way, such as drilling for hydrocarbons, was beyond our terms of reference to consider."

The study was done after Imperial had submitted and had its application to construct the island, approved. It was required by DINA, I believe, as a result of a recommendation by the Land Use Advisory Committee.

Q. What does LUAC's handling of the Immerk case indicate about its effectiveness?

A. First I must say that I have not seen the minutes of the meetings of the Committee in which the application for Immerk was considered and acted on. However, it is possible to make at least a partial assessment on the basis of what did evolve in terms of Immerk. As I mentioned earlier, Immerk was a landmark case. It was the first move to a new exploration frontier in the Arctic Ocean. The opening of this frontier was based on very inadequate environmental knowledge and on oil-spill technology that was not even adequate to deal with major spills in benign southern environments. In spite of this the only requirement made of Imperial was that it have an environmental impact assessment made of the effect of the construction of Immerk. Imperial was allowed to draw terms of reference for the study so that drilling for hydrocarbons was excluded, in other words, so that the study could not deal with the environmental impact of oil spills -a consideration which was of paramount importance to Mackenzie Bay. This clearly indicates that there were deficiencies in the environmental monitoring process associated with the application of the Land Use Regulations. However, I cannot judge whether the inadequacy that existed in the handling of Immerk occurred at the level of the Committee or higher up, as a result of recommendations made by the Committee.

having been ignored by administrative staff of the Department of Indian and Northern Affairs.

Q. What do you know about the geological formation pressures which were encountered at Immerk.

A. The occurrence of abnormal formation pressures is a topic about which very little has been said by the petroleum companies who are exploring in the Delta. Little or no information is made public about the occurrence of abnormal pressures in cases where they have been controlled and the wells completed. However, limited information was made available about Immerk in December, 1973 because in that case drilling had to be discontinued at 8,883 feet instead of 15,000, which was the targeted depth of the well. Some explanation was necessary. The statement, as quoted in newspapers, was very terse:

"The well will be abandoned because high formation pressure precluded further safe drilling." In March 1975, Mr. R.N. Daw, of Imperial Oil, presented a paper to the Canadian Society of Petroleum Geologists on the detection and control of overpressure. Oilweek reported on his talk in an article entitled Mud Weight Control in the Delta. The article included two sets of graphs from Mr. Daw's paper. One of these, Immerk Velocity Plot showed that the company had anticipated that it would encounter abnormally high pressures at approximately 7,600 feet.

However, I found evidence that indicated that Imperial Oil had provided misleading information on pressures in making application to drill Immerk. In support of its application to drill, Imperial submitted an Arctic Well Contingency Plan - Immerk B-48, Section 1330 dealt with preplanning for emergencies and contained a paragraph on formation pressures. The first sentence stated what Imperial expected to encounter in drilling Immerk. It stated: "Analysis of available velocity data indicates that pressures above a depth of 10,000 feet will be normal and equivalent to a salt water gradient."

In my opinion, it is significant that in the case of Immerk, which set a precedent for offshore drilling from artificial islands, that the Land Use Advisory Committee did not have adequate information on the existence of a situation which results in particularly hazardous drilling conditions. Tuktoyaktuk Hamlet Council also deliberated the pros and cons of the application and made its decision to approve the application without knowing that abnormal formation pressures existed which increased the risk of a blowout occurring during the drilling operation. The whole question of abnormal geological pressures and the nature of the problems associated with them should be clarified for the benefit of the people of the Delta and the Beaufort Sea. According to Oilweek much of Imperial's

acreage may be involved and this is in an area of the Delta and Beaufort Sea that is of critical importance to native people.

Q. In referring to the proposed Beaufort Sea Research Project in the COPE report stated the opinion that a research program of one-year's duration was a waste of money. That was two years ago and the research program has been completed. What is your opinion on the value of the Beaufort Sea Research Project?

A. Before assessing the adequacy and value of the project, I would like to reflect back on some of my earlier comments on which I attempted to bring out how little was known in 1973-74 about the Beaufort Sea and its ecosystems. At that time I argued that a 3-year research program was the minimum time needed to obtain the knowledge required as background to the formulation of environmental impact assessments for exploratory drilling operations and to develop oilspill technology that would have even a marginal capability of dealing with blowouts in the Beaufort Sea. The approach to the Beaufort Sea Research Project raises many questions about scientific research and its application to the assessment of potential environmental effects of major projects, such as offshore drilling in the Beaufort Sea. Two of the important ones are: How valuable is the knowledge gained through "crash catch-up programs" of baseline ecological research? Is it valid

and realistic to prepare environmental impact assessments for areas with highly variable environments, on the results of research programs which have spanned only one or two seasons? Environmental conditions vary so much from year to year that it is difficult to accept that studies of less than three years' duration could produce the understanding needed to minimize the impact of a major petroleum exploration program.

The kinds of problems which can be encountered in Arctic marine research programs were illustrated by ice conditions in the Beaufort Sea in 1974. Initial planning was for intensive research during an open-water season of two and a half months. However, as it turned out, 1974 was the year when summer virtually did not come to the Beaufort Sea. The research vessels, the MV Theta and MV Pandora were escorted by the icebreaker Camsell through the Bering Straits and into the Beaufort Sea. They did not arrive at Herschel Island until August 9th, three weeks later than expected.

The heavy ice conditions forced cancellation of some studies and allowed only limited progress to be made on a number of others. Little progress was made on Near bottom currents and Offshore Tides (Project Number D2), or on open water surface currents (Project Number D3.). The placing of offshore in-

struments for the automatic recording of data on currents and tides was part of the plan for D2; five were placed in November, 1973 and 19 in May, 1974. When the work to recover the instruments was started in August only one location was ice free. The gauges had be^{en} displaced by ice. Two weeks later they were accidentally found six miles away in the course of a helicopter flight for another project. Many of the gauges were not located during the season. The study of open water surface currents (D3) was forced to abandon its original plan and restrict efforts to nearshore currents in Mackenzie and Kugmallit Bays and in the vicinity of Atkinson Point.

Much of the work on the use of the Beaufort Sea by waterfowl and sea birds was restricted to a relatively small patch of open water north of the Tuktoyaktuk Peninsula. At no time did the area of open water extend to the sites which will be occupied by the drill ships which are to be operated by Canadian Marine Drilling (Canmar).

It is also important to recognize that the Beaufort Sea Project had important constraints other than those of time. According to the Project Leader, it was concerned only with the southeastern part of the Beaufort Sea and dealt only with the impact of the exploratory drilling phase of offshore oil operations. In more specific terms its results will

relate only indirectly to the production and transportation of oil and gas from either deepwater or near shore wells and they will not provide much insight on the potential impact of oil spills on other parts of the sea or of the Arctic Ocean. These are serious deficiencies.

I have not seen the final reports for the individual research projects so it is difficult to assess the results. However, the preliminary reports on fish, as an example, indicated that the nearshore areas are very important to fish but they fell far short of providing the detailed information on the various stages of life histories of the species which should be available for the formulation of an environmental impact assessment.

However, I must admit that now I consider that the Beaufort Sea Project was worth doing. The preliminary reports convinced me that a crash research program was better than no research at all.

Some insight on the potential adequacy of the Beaufort Sea Project is gained when it is compared with the research program which is being developed prior to the commencement of off-shore drilling in Alaskan waters. For that program:

quote from
Hendrick
"Preliminary cost estimates are \$54 million for a two-to-ten-year program to be coordinated by the U.S. (National) Science Foundation. A second \$28 million program for U.S. Arctic waters commenced in the spring of 1975, and will be coordinated by the U.S. National Ocean and Atmospheric Administration."

To sum up, I would argue that the Beaufort Sea Project should

be viewed as the preliminary phase of an extensive program of research in the Beaufort Sea. In my view, such research should have two phases: (1) a carefully developed long-term program of basic research on biological and physical aspects of the Beaufort Sea environment. There is also a need for a more specialized Environmental Impact Research Program.

(2) the highest priority would be research which is designed to identify, or predict, potential problems which could result from the various stages of petroleum development. One aspect of the research would involve environmental studies and monitoring of ongoing projects. The objectives of this program would be to determine what can be done to adapt exploration and production activities and methods in order to reduce the potential for environmental damage which now threatens from industrial development. Both programs should be developed immediately.

Q. In your opinion, are there any particularly important weaknesses in the processes involved in considering and granting approval for the construction of artificial islands and in granting authority to drill from them?

A. The fact that potential cumulative effects appear not to be considered seems to me to be a very important weakness. As I understand it, the terms of reference of the Land Use Advisory Committee result in it considering and acting on each land use application for artificial islands as if it was one of a kind rather than one of an expanding series.

The possibility that the construction of artificial islands might influence white whale migration has been a major concern of native people. The whales must have open water available to move from area to area, hence preservation of the distribution of open leads is important during breakup or during periods when the ice is on the move. It would seem possible that the presence of increasing numbers of artificial islands could change the distribution of leads during the critical periods when the whales are migrating to areas where their young are born. Similarly, the potential cumulative effect of the dredging program for island construction may warrant consideration. The near-shore regions of the Sea contain many rearing and feeding areas for fish stocks which are utilized by native people. Are there any important ones in the areas where islands are being built? If so, are they being affected by the building of islands? To sum up, I consider that the licensing process should be required to consider potential environmental consequences of the island building program on fish and whales rather than just the effect of individual islands.

- Q. In your review of IOL's report submitted with the application to construct Immerk you dealt particularly with the environmental impact of hydrocarbon spills. Is there any aspect of that question which warrants particular emphasis in offshore operations?

A. The one that has weighed on my thoughts most is the length of time that would probably be required before a relief well could be drilled to stop the flow of oil should a blowout occur. In the case of drill ships, the operating season in the Beaufort Sea could range from a month to possibly four months in duration. If a blowout occurred much beyond the midpoint of even a long season, there would be little possibility that it could be stopped by drilling before the next drilling season which would probably be eight to ten months away. If severe ice conditions occurred during the summer, as in 1974, it could be two years before a relief well could be drilled and a blowout stopped.

In the case of islands in very shallow water, the time required would probably be considerably shorter since island building operations can be conducted in both summer and winter but there is little likelihood that an island could be built and a well drilled in less than four months even under optimum conditions. Under less than optimum conditions, say for example, where operations were delayed by the break up or freeze up of the ice, the time required could be almost doubled. Then, of course, I should point out that the whole island building scene is changing. Imperial first considered building islands in water depths of up to ten feet. Now it has approval to build one, Issigak, in forty-two feet of water. That island would require over ¹~~100~~ million cubic yards of sand and gravel and will take two to three years to build. I do not know what the contingency plan for drilling a relief

well is; however, unless a drillship can be brought into play, it is difficult to conceive of a situation which would permit a relief well to be drilled in less than a year. Some of the background statistics on island building are given in a report prepared by IOL for the Land Use Advisory Committee. The applications for Imperial Issigak A-57 and Ernak I-21 provide details on construction and drilling schedules as originally proposed before the company's new dredge ship Mackenzie Beaver encountered problems in reaching the Beaufort Sea.

Q. What did you learn about the level of technological development which is represented by offshore drilling operations in the Beaufort Sea?

A. Even to a non-engineer it is evident that only modest technological adaptations have been made to meet the increased difficulties of drilling in the Arctic. The building of islands allows for a longer drilling season and apparently a more secure base against ice pressures, but an island does not meet the needs of the Arctic environment if a blowout occurs. The support for this statement is evident from the answer to the last question.

Frequent mention is made by members of the petroleum industry about the fact that the drillships which will be used in the Beaufort Sea are ice-strengthened. However, it is evident that this adaptation is required for even summer drilling operations in the Beaufort Sea. (This is illustrated by the

fact that the hull of IOL's new ship-dredge, the Mackenzie Beaver, was damaged in 1975 trying to get into the Beaufort Sea to add to IOL's island building fleet.) The strengthening of the hull adds very little to the capability of the ship to lengthen the drilling season since there would be very little possibility of it drilling more than four months even during the most favourable season. This hardly represents technological development of drilling systems which are adequate for use in the Arctic.

The development of technology which would permit systems to face Arctic conditions on more equal terms has been the subject of considerable discussion. There were papers on the topic at the Northern Canada offshore drilling meeting in 1972; at an international congress in France in 1973 and there have been a series of recent papers in the petroleum press during the past year. However, the thing that appears quite clear is that there is little likelihood of dramatically new systems coming into use in the Beaufort Sea before the 1980's and even this applies only to areas within the shorefast ice zone.

In 1973, approximately three months before Cabinet gave approval in principle to the operation of drill barges in the Beaufort Sea, an official of Shell Oil gave an indication of the state of technology:

"Although a large amount of literature has been published on and about the Arctic, design engineers have found little useful data pertaining to ice strength,

ice movement, ocean floor conditions and other environmental factors that will affect work in the Arctic offshore waters and are required for the determination of the basic design criteria."

Q. In the COPE report and again just now, you referred to the use of drill barges in the Beaufort Sea. Is drilling not to be done from drillships rather than drill barges?

A. Until 1974, all discussion centered around the use of drill-barges. There were two papers on them at the NCODM; they were the basis for DINA's position on Exploratory Drilling for Oil and Gas and for the Cabinet memorandum on offshore drilling. A lot was made of the fact that studies sponsored by the Beaufort Sea Task Force and Hunt Petroleum had arrived at independent conclusions which favoured the use of a barge drilling system. The Position paper on offshore drilling stated that the proposed systems were satisfactory and a barge system was recommended to Cabinet. But throughout this period the possible use of drillships was not brought out into the open. Dome Petroleum was represented at the NCODM but did not mention any plans for the use of drillships in the Beaufort Sea. However, in March, 1974 when Mr. Chretien stated publicly that approval had been given for the construction of a drilling system for the Beaufort Sea, it became evident that the whole game plan had changed; approval had been given to Dome not to Hunt or the BSTF and to a drillship system not to a drill barge. I did not learn why the sudden shift had occurred. If barges represented an adequate

system in July, 1973 when the concept was approved by Cabinet, why was the concept discarded within a few months?

Q. Do you have any other concerns about the use of drillships in the Beaufort Sea?

A. Yes.. As far as I have been able to learn no assurance has been given that the two drillships will be tested in less rigorous environments before they begin operations in the Beaufort Sea. The Department of Energy Mines and Resources has a policy that no system will be used for the first time in Arctic waters which come under its jurisdiction. I consider that the same policy should apply to the Beaufort Sea. Since a blowout could take up to two years to stop, it is not a suitable place for the testing of equipment or for the training of crews.

Q. What did you learn about possible methods of producing oil and gas from wells in the Beaufort Sea?

A. As a preface to my reply, I should say that the Beaufort Sea environment is very different from the Gulf of Mexico or from Cook Inlet in Alaska. Arctic pack ice would destroy any production platform that is now used in any of these areas. In such areas, these fixed platforms are being built in water over 800 feet deep. However, it would seem that subsea completions (which involved placing the wellhead on the ocean floor) and subsea production facilities (which

operate automatically and which can handle a series of wells) are potentially feasible for some areas of the Beaufort Sea. However, ice scouring will pose a threat to such facilities in waters from 35 to 150 feet deep. The presence of undersea permafrost will also constitute a threat in some areas. However, it can be detected in advance.

Subsea completions are well advanced in terms of practical use. In 1973 more than 70 were in use in U.S. offshore waters. The state of development of subsea production systems is not as advanced. In 1973 two prototypes were being tested under field conditions and another system was being designed. A subsea production system reported suitable for Arctic operations is being designed by Lockheed Petroleum Services. Where artificial islands are being used for exploration, they will also probably be used for production. However, they will probably require more protection from the action of waves and pack ice. Imperial Oil recently made this statement about its production facilities:

"All of our islands built to date have been designed only to support exploration wells. It is not intended that they be used as permanent structures. The method of construction for permanent islands is still in the planning stage. These will be designed to maximize the utilization of the exploration islands."

As an alternative or perhaps as an addition to manmade islands Imperial has designed a conical monopod-like structure

for use in ice-infested waters. The system has apparently received approval in principle from DINA: although, as far as I know, no announcement has been made on plans to construct a prototype.

Q. What did you learn about the transportation of oil and gas from offshore?

A. It appears that major advances must be made in technology in order to get oil or gas to shore. In other areas, transportation has been by pipeline or by tankers. However, it does not seem that tankers will be feasible in the Beaufort Sea.

A feasibility study for an offshore pipeline in the Beaufort Sea is being conducted by APOA at a cost of \$75,000. According to APOA, the purpose of the study is:

"To determine the technical feasibility of installing pipelines offshore Mackenzie Delta to the 150' water depth contour. Estimates of installation costs are to be provided in order to establish economic feasibility. Laybarge, Pull, and Reel-barge pipelaying methods are to be considered, limits of technical applicability for each method are to be established and problems identified. Thermal effects of the pipeline will be examined and adequate measures to prevent melting of any existing offshore permafrost will be considered. The study will analyze available scour information, evaluated risk and determine pipeline burial requirements and costs. Trenching techniques form an important aspect of the study. The project is essentially a feasibility study of Arctic offshore pipelines and not a detailed design for a specific line and route. Although certain specific factors in a specific area are being considered, the range of conditions in which a specific recommendation might apply will be given. The sensitivity of any recommended pipeline installation technique to changes of conditions will be indicated."

In addition to potential problems from scouring and permafrost, surface ice will frequently make both maintenance and repair operations difficult or impossible. Technology is being developed which may eventually handle repair operations under land fast ice but repairing a pipeline under the polar pack and along the shear zone will be much more difficult to accomplish.

CAGSL stated that limited access for maintenance of a pipeline presents serious operational reliability problems. It suggested that in water 20 to 30 feet deep, maintenance access might be extended to 7 to 8 months with the use of air-cushion support barges.

"However, any type of repair during the break-up and freeze-up would appear not to be feasible even with the air-cushion support vehicle and submersible pipeline repair system."

In summation, it is clear that the technology does not yet exist which can ensure that oil or natural gas can be transported to land without the environment being under constant stress from oil spills. In addition, I have not been able to determine that much is being done in advance of discoveries which would result in pressures for quick solutions to the large technological problems which are posed by the harsh physical environment.

Q. What is known about spills of oil from production systems and underwater pipelines?

- A. Spills during production and transportation remain a persistent, chronic problem in the development of offshore petroleum resources. In the Cook Inlet area of Alaska, there are 14 producing platforms, 13 oil and one gas, from which pipelines extend to the shore. In 1968, 26 spills occurred in the Inlet itself. Some slicks extended many miles and the industry estimates them to have involved more than 1,000 barrels of oil. Five pollution incidents have resulted from a single pipeline installation." In total, over 150 pollution incidents were recorded in the Inlet from 1965 to 1968. In November 1967, oil from an unknown source killed an estimated 1,800 to 2,000 sea ducks and other water birds.

Three major spills have occurred from platforms in the Gulf of Mexico since 1969: "In the Shell accident (1970), estimates of oil lost range from 53,000 to 130,000 barrels. The Chevron accident resulted in loss of 30,500 barrels. Finally the Amoco accident (1971) resulted in loss of 400 to 500 barrels." From 1964 to 1972 there were nine spills from offshore platforms in the United States which resulted in spills of more than 1,000 barrels of oil. The range was from 1,600 to 77,400 barrels. During the same period there were eight spills of over 1,000 barrels from pipelines. They ranged from 1,000 barrels of oil to one of 157,000 barrels. In offshore operations in the U.S., which were under control of the federal Government, from 1954 to 1971, one-eighth of a barrel of oil was spilled for every 1,000

produced.

The authors of Energy ^{under} from the Oceans, an extensive assessment of offshore technology in the U.S., concluded that each year one in 3,000 production wells is involved in a major accident, that is, an accident which results in inquiry and property or environmental damage. There were 43 such accidents in outer continental shelf operations between 1953 and 1972. They resulted in 56 deaths and in spills which totalled between 290,000 and 1.1 million barrels of oil. The Council on Environmental Quality (CEQ) summed up the statistical chances of major spills occurring from platforms and pipelines for an oil field of medium size.

"There is about a 70 percent chance that at least one platform spill over 1000 barrels will occur during the life of the field. For a small oil field find, there is about a 25 percent chance of one platform spill over 100 barrels and for a large oil field find, there is over a 95 percent chance of a platform spill over 1000 barrels, during the life of the fields. The probability of pipeline spills follows the general pattern exhibited by platform spill statistics."

In discussing the oil spill problem in Cook Inlet, a U.S. scientist who was familiar with the development of the area, pointed out the fact that industry management "apparently desires to maintain a reputation for good citizenship by running a clean operation. Implementation of this desire at lower echelons is difficult, however." He also cited the problem of prosecuting offenders, because legislation requires that gross negligence be proved. The result was that only five of 150 incidents resulted in prosecutions. He also im-

plied that the safety factors necessary to protect the integrity of oil production and transportation systems against unforeseen conditions were developed by trial and error instead of at the drawing board: "Five pollution incidents stemming from one pipeline in Cook Inlet have emphasized that we cannot afford designs that must be improved upon as a result of repeated failures in the field."

The human factor as a cause of oil spills is emphasized repeatedly in the literature, and it is illustrated in the statistics on the drilling of development wells. According to the CEQ, development drilling is generally less hazardous than exploratory drilling because the characteristics of the geologic formations are better known. However, a survey of 32 wells which had blown out showed that 65% of the wells had been development wells; because drillers act with more caution on exploratory wells, there is an extra margin of safety which makes the difference.

- Q. How would you sum up your personal feelings or conclusions about offshore drilling in the Beaufort Sea?
- A. In the first place, I consider it regrettable that plans for offshore drilling have been made in such an ad hoc way in terms of democratic political processes. In my opinion the whole question of northern petroleum development ^{sh}ould at least have been brought into national perspective by a government white paper so that the complex social, political

economic and environmental issues could at least have been discussed and debated as part of a decision-making process.

As far as I am concerned, the approach that has been used violates any reasonable interpretation of the statement of government policy on northern development in the 1970's.

It also violates a reasonable interpretation of the way that the development of non-renewable resources should be balanced balanced with societal and environmental concerns and interests.

Dealing with offshore drilling in the Beaufort Sea specifically, I consider that it is a case where exploration of petroleum resources is being done at least a full decade ahead of the development of technology which would permit drilling systems to cope with the forces of the physical environment with even modest capability. The same basic statement applies to the relationship between development and understanding of the Beaufort Sea environment.

In my opinion, the government is making a serious mistake in licensing offshore drilling operations in the Beaufort Sea now.

I do not consider that it is in the national interest to put at risk the natural resource base of northern native peoples and the arctic environment in this way at this time.

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Doug Pimlott was born and raised at Quyon, Quebec. His first job was with the Federal Department of Agriculture at Ottawa prior to World War II. He served for five years in the R.C.N. in ratings and ranks which ranged from ordinary seaman to First Lieutenant of a Frigate. After the war he graduated in Forestry from the University of New Brunswick and received graduate degrees in Wildlife Management and Zoology at the University of Wisconsin.

He was employed in wildlife research and management with the Newfoundland Government from 1950 to 1957. He was in charge of wolf research for the Ontario Department of Lands and Forests from 1958 to 1962 when he joined the Department of Zoology of the University of Toronto. He now holds a cross appointment with the Faculty of Forestry and is a Fellow of Innis College. His teaching at U. of T. has been primarily in ecology, various aspects of resource management and in environmental issues and problems. He also is the co-author of a number of books and the author of many technical and popular publications on wildlife ecology, resources and environmental topics. He is best known for his writings on wolves, parks and wilderness and more recently for his work on environmental problems in the Arctic. He maintains an active involvement in conservation and environmental organizations. This aspect of his interest is based on a deep conviction, gained during his years of service in Government, that they are of vital significance in allowing Canadians to evaluate issues where social, environmental and developmental options are intricately interwoven.

He is a past president of the Canadian Nature Federation, a former chairman of the Canadian Arctic Resources Committee, past president of the Canadian Society of Zoology. He is presently chairman of a World Wolf Conservation Group of the International Union for the Conservation of Nature and Natural Resources (IUCN), Morges, Switzerland. In 1969-70 he was leader of a study on fisheries and wildlife in Canada (Background Study No.15) for the Science Council of Canada.

He directed and participated in ecological studies of wolves and caribou on Baffin Island between 1965 and 1970. He worked full time as a Resource Worker with the Committee for the Original People's Entitlement (COPE) at Inuvik, N.W.T., from September 1973 to August 1974. He expects to continue to work actively with the Canadian Arctic Resources Committee (CARC) and with native organizations in the N.W.T.

List of Publications

by Douglas H. Pimlott

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- 1961 - Wolf control in Canada.
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